

Polaris

A Solar Farm
Performance Simulator



where business meets innovation

New Technology from DIT



A highly accurate PV simulation tool

Polaris is a highly accurate simulation tool for the prediction, control and optimisation of utility scale solar photovoltaic (PV) power plants which can enhance their development and operation.

Solar farms have become more complex as they increase in size, covering areas with multiple distinct weather zones, and using multiple different solar technologies. While tools to support planning have progressed rapidly, there is still a

significant shortfall in tools designed to support the operation and maintenance of solar farms and to support the grid authority.

Polaris addresses some of the key challenges and uncertainties currently experienced by both solar farm and solar grid operators. Through simulation, highly accurate predictions can be achieved for PV farms in terms of their power output, including fluctuations caused by changing weather conditions. The energy yield predictions can be used to independently validate the performance of PV Systems.

Polaris is based on an extensive simulation model. Using a purpose built algorithm, Polaris can perform a variety of monitoring and control functions. These include calculation of PV power plant energy yield and independent performance validation; measurement of shading and fault effects on energy yields; economic feasibility modelling; fault detection and analysis; and supply-side energy smoothing across multiple PV power plants.

Applications

Polaris has been developed to support the needs of solar farm Designers, Planners, Developers, Operators, as well as the Grid Operators. Key functions include:

- **Design and planning** – Accurate farm modelling and projected power calculations.
- **Commissioning** – Actual power versus predicted power analysis for commissioning support.
- **Operating** – Actual power versus predicted power analysis for fault identification and prediction.
- **Electricity Sale** – Near term precise power output and fluctuation projections for power to grid sales.

Opportunity

Solar power is a maturing sector. After rapid growth over the last decade, average PV module prices have fallen more than 80% since 2008, amid a glut in supply. However this has opened new doors for companies supplying solar systems. Unsubsidised PV developments are now beginning to occur in Europe, with examples in Germany and Spain, but primarily on an individual premises sub-MW level.

According to the EPIA, the market for PV is growing strongly with the world's cumulative PV capacity surpassing 100 GW of installed capacity in 2012. Roughly 31 GW of that capacity was installed during 2012. Based on the installed capacity in Europe, PV can now supply 2.6% of the EU's energy needs.

Research indicates that there are two types of customers who would have an interest in Polaris. These are New large solar farm operators and Small-sized solar farm operators (0.5MW to 5MW PV farms).

While most of the large farm developers and operators already have their own in-house developed software, newer entrants in the market have not yet developed such software and the possibility of using Polaris is appealing to them as it would accelerate their own development work.

In the small sized solar farm category, operators do not have the same in-house capability. These companies are interested in any software which can deliver even a small performance improvement.

Advantages

Polaris uses advanced features to deliver unprecedented levels of accuracy and functionality:

- Models every cell individually within the farm (millions of cells in larger farms).
- Models all the cell to cell electrical connections.
- Cell shading is accurately modelled.
- Can model complex solar plants with multiple "weather zones" and multiple different renewable energy technologies (e.g. different PV, CPV, wind, solar thermal, etc).
- Specially purposed algorithms allow the system to learn the response of each individual cell delivering more accurate

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predictions and trend analysis for early fault prediction and detection.

- Energy yield, fault & shading analysis, and economic modelling features allow the user to carry out feasibility analysis.
- Fault/Shading detection and supply-side smoothing/bid prediction features may be incorporated into automated systems with sensor readings, simulations and energy calculations in real-time.
- Polaris is command line driven so that it can be incorporated into other (automated) systems, delivering flexibility.

Stage of Development

Polaris has been developed by researchers in the Electrical Power Research Centre (EPRC) supported by funding from Enterprise Ireland.

The technology is capable of demonstration as a simulation tool but further development work may be required to develop a Graphical User Interface (GUI) suitable to an end-users needs.

The modelling algorithms, developed in excel and C+, are protected as secret know-how.

DIT is currently seeking expressions of interest from software companies interested in licensing the simulator for development as a new software product for the PV market.

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